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INSTRUCTIONS GEI-19645-K
HC-25-C1 CATHODE RAY OSCILLOGRAPH

CATALOG #5142111G1

GENERAL ELECTRIC CO.
SCHENECTADY, N.Y.

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These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

INSTRUCTIONS GEI-19645-K

HC-25-C1 CATHODE RAY OSCILLOGRAPH

Catalog #5142111G1

I. INTRODUCTION

The HC-25-C1 cathode ray oscillograph is an oscillograph for the observation and photographic recording of high speed transients such as produced by surge generators or by sudden changes in a circuit. Its visualizing element is a cathode ray tube of hot cathode sealed off design whose screen may be photographed by a camera and simultaneously viewed by the operator.

II. DESCRIPTION

Photograph No. 1081809 shows an oblique front view, photograph No. 1081810 a rear internal view and photograph No. 1081811 an internal side view showing the sweep chassis. The cabinet is about 27" x 27" x 70" and all controls are above the 30" level so that a table or desk may be built around it.

In the back a full sized door gives easy access to all components and connecting cables are coupled to connectors on a narrow panel at the bottom. Near the top is the cathode ray tube with a magnetic shield around it. Attached to the shield is a metal box containing the resistance voltage divider and the selector switch and the oscillator chassis is attached to the bottom of this box. On the next lower level are the 300 volt and 900 volt power supplies for the sweep circuit. At the bottom are the 25 KV power supply for the cathode ray tube and a voltage regulator. The sweep chassis is mounted on the left side so that

its inside connections are accessible when the side panel is removed.

III. SETTING UP

The oscillograph is shipped with all tubes packed separately. The small tube sockets are marked with the tube type numbers. The instruction book on the voltage regulator shows locations of its tubes. The D.C. calibration circuit is on the front panel and its tubes mount horizontally.

The cathode ray tube 5RP2A is installed as follows:

*see the
available*

1. Remove top of cabinet.
2. Remove top of magnetic shield.
3. Place tube in shield in approximate position with accelerator ring terminals to left.
4. Connect leads to rings in same order in which they come thru right side of shield.
5. Connect other leads according to tag numbers to deflection terminals which are counted 1 to 5 in a counterclockwise direction *looking from socket end.*
6. Replace top of shield being careful to see that high voltage leads are properly placed.
7. Turn tube so that ring terminals are on horizontal center line.
8. Adjust lengthwise so that screen is 2" back from front panel.
9. Adjust deflection and sweep leads for maximum separation from each other.

IV. CIRCUIT DESCRIPTION

1. 115 Volt Circuits, M-5113137

This shows the 115 volt wiring and is fairly obvious. A time delay relay provides a one minute interval for filament heating before high voltage circuits can be turned on. ~~Neon~~ ^{Incandescent} lamps in ~~parallel~~ ^{series} with fuses will indicate a blown fuse. The saturated core type voltage regulator provides +0.2% regulation for the high voltage supplies.

2. High Voltage Circuits, M-5113134

This shows the excitation, and deflection circuits of the cathode ray tube in detail.

The cathode excitation consists of two sources, one a -4 KV half wave rectifier with 0.5 MA divider and a +21 KV voltage doubler circuit with 0.35 MA divider. Jacks on the front panel permit plugging in a milliammeter in the ground ends of the resistance dividers. The current values marked on these jacks are only nominal and some variation may be expected.

The deflection selector switch provides forward and reversed connections of the deflection plates. This permits deflection in the same direction for either polarity of deflection voltage. Vertical bias on the deflection in either direction is obtained by control of the voltage on the plate which otherwise would be grounded.

The resistance voltage divider provides 75 ohm termination for the deflection cable with ratio steps as shown.

3. Power Supplies, 300V-M-5113146, 900V-M-5113147

These are conventional full wave rectifiers with filters. There is also a -640V supply on the 300V chassis for bias and calibration purposes.

4. Calibration Circuits M-5113150

This shows the D.C. calibration circuit and the timing wave oscillator. The D.C. voltage is held constant by VR tubes and wire wound precision resistors. An occasional check with a milliammeter plugged into the jack on the front panel is necessary to maintain accuracy. The 50,000 ohm potentiometer may be adjusted with a screwdriver thru a hole in the front panel until the meter reads 2.50 milliamperes.

The oscillator has four tuned circuits which are adjusted to better than $\pm 1\%$. Better accuracy than this is unnecessary as precise correlation between voltage and time elements in impulse testing is hardly possible anyway.

5. Sweep Circuit M-5113143

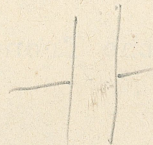
The purpose of this circuit is to produce two voltages of opposite polarity varying linearly with time over a range of some 500 V which connected to the time axis plates of the cathode ray tube produce a linear time axis. Voltages and steady state currents are shown for each tube. A jack in the ground return of each tube carrying steady state current permits convenient checking of tube currents. Operation is as follows - Time axis of 1, 2, 5, 15, 35, 70, 250 and 1000 micro-seconds are provided. A positive pulse of about 25 volts is received on the input terminal from the time delay circuit (described later). This is inverted by tube 1 and fed into tube 2 which with tube 3 constitutes a multivibrator circuit. This triggers off the multivibrator with the result of a square front pulse being put out by tube 3. This cuts off tubes 4 and 5. Cutting off tube 4 causes its plate

$$Q = CE$$

$$\frac{dQ}{dt} = i = C \frac{de}{dt} = \frac{2}{5}$$

$$i = \frac{200 \times 10^{-12} \times 1000}{10^{-7}}$$

$$i = 200.0 \times 10^{-3}$$



voltage to rise 200 volts. This 200 V pulse is coupled to the control grid of the cathode ray tube and serves to reduce its bias so that the beam is established.

Cutting off of tube 5 permits tube 6 to continue carrying its steady state current by drawing upon the charged capacitor C. The linear discharge of C produces the driving signal for tube 7 which in turn drives the final push pull tubes 8 and 9.

As the sweep progresses the current in tube 8 rises and consequently the drop across its cathode bias potentiometer. The potentiometer provides an adjustable feedback signal which drives the multivibrator back to its steady state condition thereby shutting off the beam at the end of the time axis.

This circuit is somewhat critical of the type of pulse that will trigger it. A steep front of +20 volts or so with slow unidirectional tail is preferred. With slower fronts greater amplitude is required especially with the faster sweeps. Oscillations in the signal may cause disturbances in the multivibrator resulting in a shortened sweep or other irregularities.

6. Time Delay Circuit M-5113145

This is built into the sweep circuit chassis and its terminals are shared with the sweep terminals. To trace its action it is necessary to refer to the 115 volt circuit diagram M-5113137.

The purpose of this circuit is to provide the initiating pulse for the sweep circuit and a positive pulse of higher value for tripping a thyatron in the trip surge generator. This generator is a separate piece of equipment used for coordinating the oscillograph and a large surge generator. The time interval between these two pulses is adjustable by means of the resistor R

which is on a tap switch geared to the sweep switch. Fine adjustment is by means of the variable capacitor.

Pushing the green button closes relay 2 first and then relay 1. Relay 2 prevents firing of tube 2 and relay 1 causes firing of tube 1. Terminal 3 is either grounded solidly or thru a synchronous switch associated with other surge generator equipment.

For observing surge generator transients the red button is operated closing only relay 1. When tube 1 fires, the grid of tube 2 is started upward thru resistor R and as it changes from negative to positive it fires. This sends a positive pulse out to trip the trip surge generator.

V. PHOTOGRAPHIC RECORDING

The camera is mounted on the front of the camera holder with control knobs on the top and is held in place by two knurled nuts. Its lens speed of F1.5 is required only on the faster sweeps. F4 or even F6 will give good results on the slowest ones. Eastman super\pan XX35/mm film and D72 developer has been used for years although there may be some faster films now available such as Linagraph Pan.

On the bottom side there is a small catch which may be turned 90 degrees to remove the top half of the film holder. The film spool is placed in the left end and the film moved toward the right by turning the winding knob as shown by the arrow. When a roll is finished, the winding knob will not turn and the film must be rewound into its original container before removal. Before re-rolling the winding knob is pulled out about 1/8" to release the free wheel mechanism in it which keeps the film tight. Near (on next page)

the winding knob there is a small button which must be pressed to allow winding up each new exposure. However, in this application two or three records may be taken on the space provided for an exposure by moving the film less than the full amount each time.

A solenoid operated shutter is located inside the camera holder. It may be turned off by means of the shutter switch on top of the camera housing. The lens shutter is normally left open and all recording done with the solenoid shutter. An interlock on the solenoid shutter prevents time delay circuit operation before the shutter is fully open.

VI. OPERATION

Connecting cables all attach at the lower rear panel. A three conductor plug carries 115 volt 60 cycle supply and ground leads. Other coaxial cable plugs are marked and are for -

1. resistance voltage divider
2. deflection plate
3. pulse and bias to trip surge generator
4. for connection to synchronous switch or ground.

The 115V switch is closed first and after a minute for heating the 900 volt switch is closed. The 300 volt switch should be closed a few seconds later. This is to prevent excessive screen grid currents in the 4D32 tubes which would flow if the procedure was reversed. The 25 KV is turned on last after making sure that the intensity knob is on zero. It is a good precaution to be looking in at the screen whenever turning on the cathode excitation and to keep one's fingers on the switch ready to turn it off in

case of any trouble. If the cathode beam is established in a spot with any intensity it will melt a hole in the screen in a few seconds.

For long life the tube should be operated at intensities as low as will give good results for the particular type of work being done.

Operating potentials on the grid and focusing anode vary from tube to tube and therefore three extra potentiometers are mounted on the beam control sub-panel for making adjustments beyond the range of the dial controls.

These potentiometers are shown on the high voltage circuit diagram. The one near the intensity control is set so that with the intensity control on zero the slowest sweep is just barely visible. The two near the focus potentiometer are always operated together so that they both have the same angular setting. These are adjusted to bring the focus points near the middle of the dial. Focus knob setting will remain about constant for all sweeps except the two fast ones. For these two it will require turning one way or the other perhaps a half turn

VII. TROUBLE SHOOTING

1. Loss of Intensity. Check-4KV and 21KV resistor currents in jack with milliammeter. 21KV will be low if one rectifier tube fails.

2. Trouble in sweep. Check tube currents with plug-in milliammeter. Check all voltage points. Check tubes. Look for burned out resistors or broken down capacitors.

3. Poor focus on film with good focus on screen. Check tube position. Screen should be 2" back from panel.

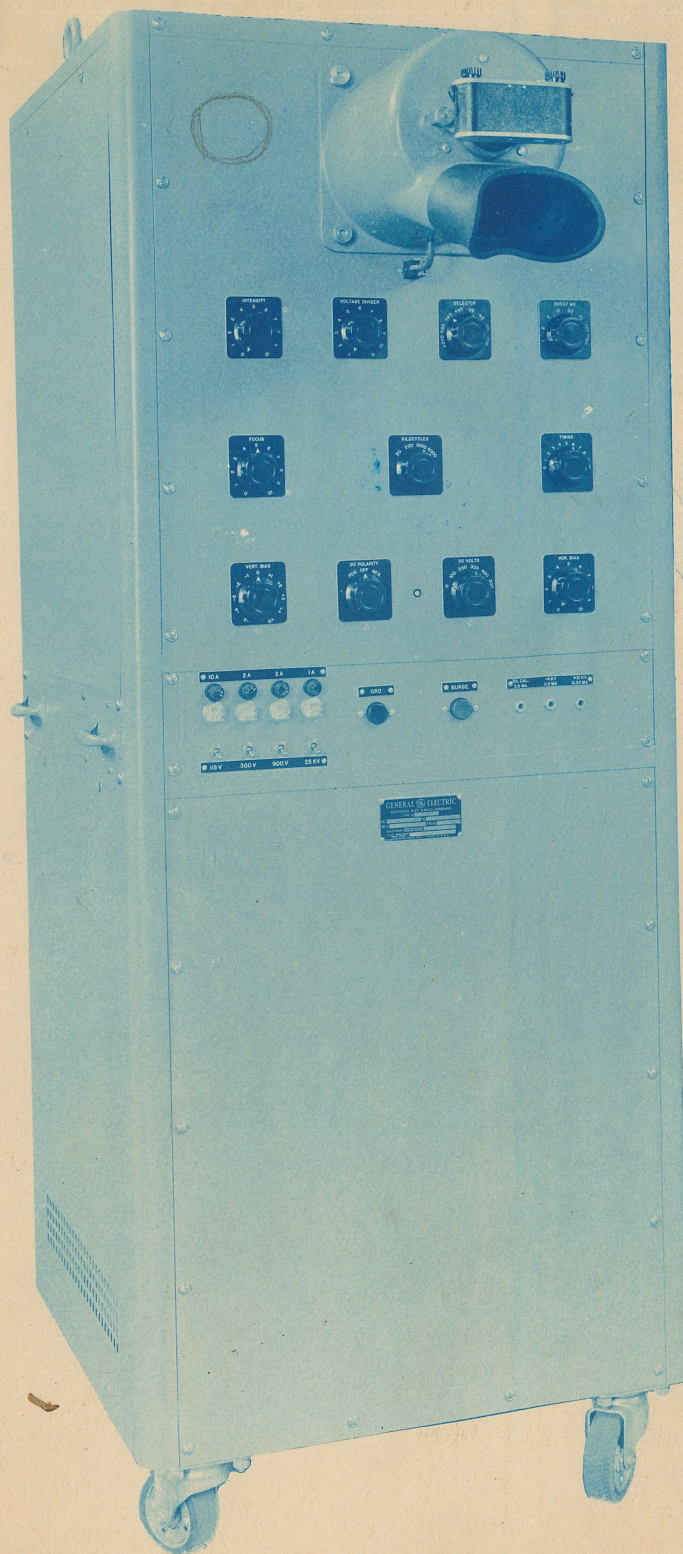
Of course with a complex instrument of this kind there can be as many causes of trouble as there are components and trouble shooting instructions would fill a book if everything was included. Therefore, no attempt will be made to go into more detail. A careful study of the diagrams and a good understanding of the theories involved will help more than a lengthy instruction book.

VIII. RENEWAL PARTS

Order 5RP2A (green long persistence screen) or 5RP11A (blue short persistence screen) cathode ray tubes direct from the Allen B. Dumont Company. Other parts from the General Electric Company, Schenectady - General Engineering and Consulting Laboratory.

IX. CAUTIONS

1. Always be sure that oscillograph cabinet is grounded before operating
2. Use fuses of the sizes engraved on marker plates to get adequate protection
3. If any work is to be done on the 25KV supply, its capacitor bushings should be grounded to take off any residual charge. This should be done after allowing about 15 seconds for the charges to leak off thru the resistance divider.

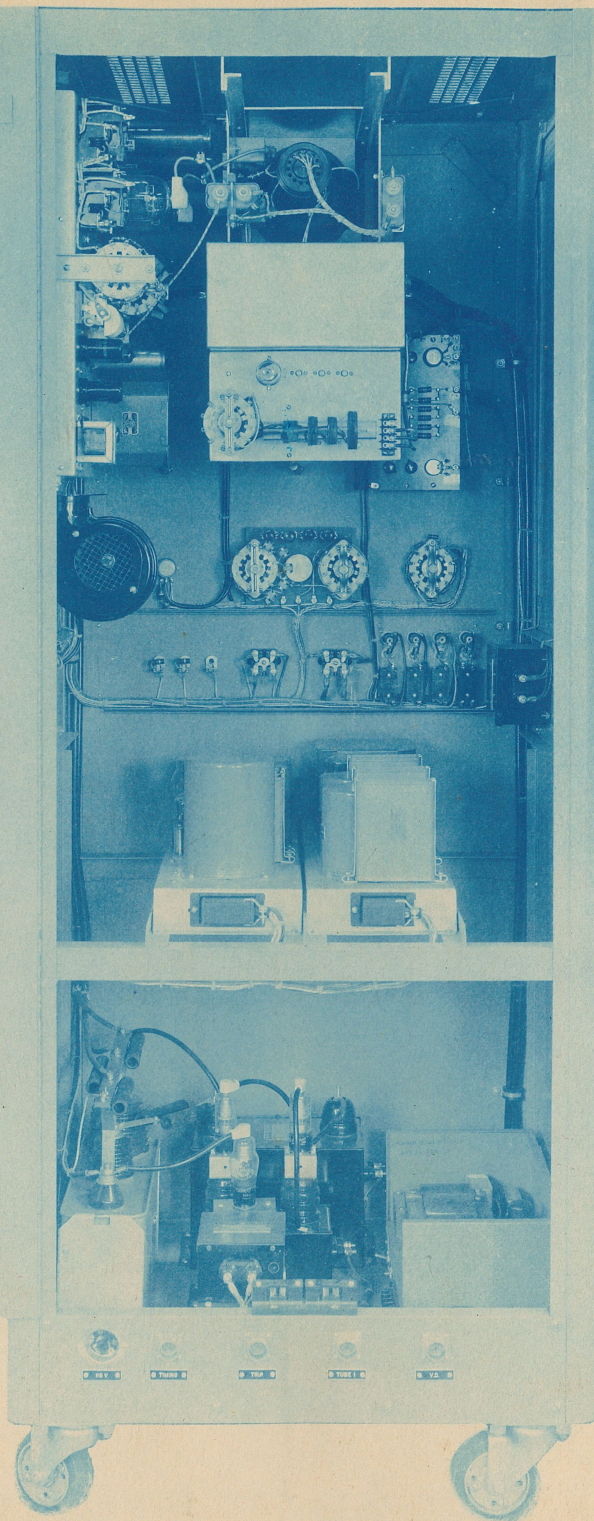


1081 809

G-E CATHODE-RAY OSCILLOGRAPH, TYPE HC-25-C1. REAR DOOR OPEN. REAR VIEW.

F369.1

5-5-50

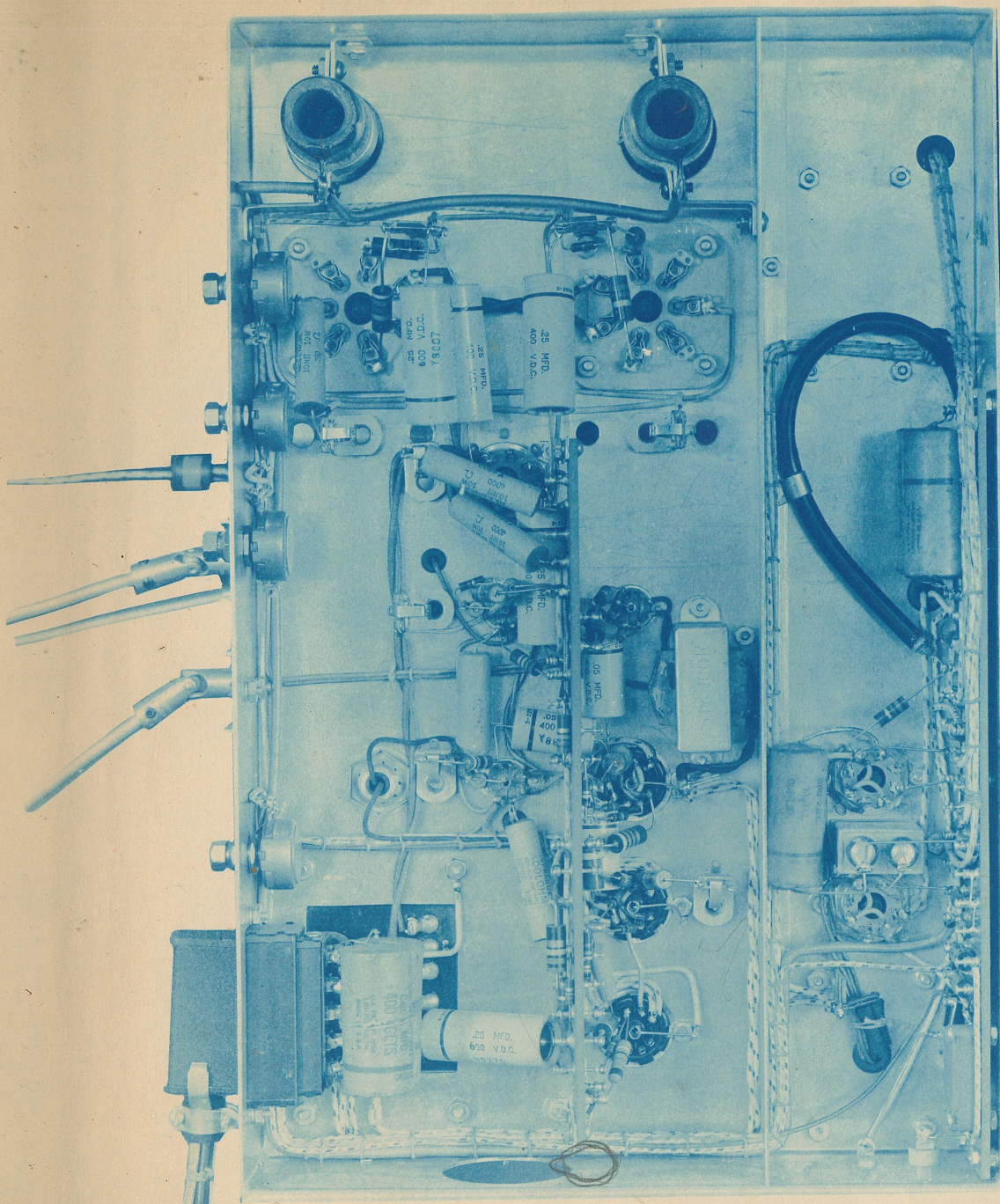


1081 810

G-E CATHODE-RAY OSCILLOGRAPH, TYPE HC-25-C1. SIDE VIEW SHOWING INTERIOR.

E369.1

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1081 811

G-E CATHODE-RAY OSCILLOGRAPH, TYPE HC-25-C1. FRONT VIEW OBLIQUE FROM LEFT.

E369.1

5-5-50